

transdermal or the transmucosal to determine whether conduction of electrical output into the transdermal or transmucosal is normal or abnormal.

The aforementioned configuration makes it possible to accurately determine the conduction state for an iontophoresis apparatus.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a general cross-sectional view illustrating an example of an iontophoresis apparatus according to the present invention;

FIG. 2 illustrates an example of an output current detecting circuit;

FIG. 3 illustrates an example of an output current detecting circuit;

FIGS. 4(a)-(d) illustrate voltage waveforms or current waveforms on various parts;

FIG. 5 illustrates an example of a residual voltage detecting circuit;

FIG. 6 illustrates a voltage waveform across the output terminals of the residual voltage detecting circuit;

FIG. 7 illustrates a device for iontophoresis that incorporates a reactive current detecting circuit; and

FIG. 8 illustrates a device for iontophoresis that incorporates a residual voltage detecting circuit.

#### BEST MODE FOR CARRYING OUT THE INVENTION

FIG. 1 is a general cross-sectional view illustrating an example of an iontophoresis apparatus according to the present invention. As shown in the figure, the apparatus comprises a preparation 80 for iontophoresis, which holds a drug or drugs and a device 90 for iontophoresis, which serves as a power supply for generating an electrical output that supplies the drug from the preparation to the transdermal or the transmcosal. The preparation 80 comprises an insulation substrate 1, a drug reservoir side electrode 2, an electrolyte reservoir side electrode 3, a drug reservoir 4, an electrolyte reservoir 5, and tabs 6A and 6B for detachably attaching a device 90 to the preparation 80. The tabs 6A and 6B are connected to the electrodes 2 and 3, respectively. The device 90, as mentioned below, includes a circuit that detects a value reflecting a capacitance of the transdermal or the transmcosal to determine whether the electrical output flows normally through the transdermal or the transmcosal.

An iontophoresis apparatus according to the present invention can be of any type that can be used in a conventional manner. In other words, the apparatus comprises a power supply, electrodes, at least one drug reservoir, and at least one electrolyte reservoir. (If there are two or more drug reservoirs, the electrolyte-holding reservoir is not essential). The drug reservoir and electrolyte reservoir may be attached to, for example, the skin or the transmcosal directly or indirectly.

When the iontophoresis apparatus is operated, charges

are stored in the transdermal or the transmcosal. This is referred to as a capacitance of the transdermal or the transmcosal. For example, when the drug reservoir and electrolyte reservoir are not in intimate contact with the transdermal etc., the capacitance of the transdermal etc. causes a decrease in reactive current and a decrease in charge (an element determining a time constant of the residual voltage) stored in the skin. When this happens, for an output voltage, it causes that the reactive current does not reach a predetermined value or the residual voltage does not reach a predetermined value. Thus, detecting the the reactive current or residual voltage allows accurate, quick determining of current a conduction state of the iontophoresis apparatus, thereby being able to prevent an abnormal condition.

When abnormal conditions occur such as damage to the skin, short-circuit due to poor printing of conductive paste during the manufacture of the drug reservoir side electrode and the electrolyte reservoir side electrode, or short-circuit etc. due to perspiration etc., the DC impedance prominently drops so that the DC current exceeds a predetermined value. Thus, these abnormal conditions can be determined by detecting a DC impedance as in the conventional art.

The impedance of the capacitance (described below as capacity) of the transdermal and the transmcosal, for example, described in "IYODENSHI TO SEITAIKOGAKU" Vol. 11, No. 5, pp337-343. According to this document, using an electrode about 9 mm ( $0.64 \text{ cm}^2$ ), subjecting the transdermal to hydration